CLAIMS

1. A memory device comprising a molecular memory, characterized in that said molecular memory comprises storage means made by means of DNA strands, and connection means made by means of carbon nanotubes for electrical contacting said storage means.

2. The storage device according to Claim 1, characterized in that the storage of information in said storage means is obtained by hybridization of said DNA strands.

3. A method for manufacturing a memory device, comprising the step of creating a molecular memory, characterized in that said step of creating a molecular memory comprises the step of making memory elements using DNA strands, and connection elements using carbon nanotubes for connecting said memory elements.

4. The method according to Claim 3, characterized in that it further comprises the step of hybridizing said DNA strands for storing information in said memory elements.

5. The method according to Claim 3, characterized in that said step of making memory elements and connection elements comprises the steps of:
- forming an array of first nanoelectrodes on a substrate of insulating material;
- forming on said substrate a plurality of carbon nanotubes;
- functionalizing said nanotubes so that they will be suitable for making contacts with DNA strands;
- contacting said first nanoelectrodes and said nanotubes using DNA strands;
- hybridizing or not hybridizing said DNA strands according to the information that is to be stored.

6. The method according to Claim 5, characterized in that said step of forming a plurality of nanotubes comprises the steps of:
- forming on said substrate an array of second nanoelectrodes;
- depositing a catalyst on the second nanoelectrodes, among which said nanotubes are to be grown;
- subjecting said catalyst to calcining so as to form metallic nanoparticles acting as

seed for the growth of said nanotubes; and
- growing said nanotubes.

7. The method according to Claim 6, characterized in that said step of growing said nanotubes comprises the step of performing a chemical vapour deposition (CVD) assisted by an electric field (E) such as to favor the oriented growth of the nanotubes.

8. The method according to Claim 5, characterized in that said step of forming a plurality of nanotubes comprises the step of arranging the individual nanotubes in the desired positions, making use of a manipulator.

9. The method according to claim 5, characterized in that it further comprises the step of functionalizing said nanotubes.

10. The method according to Claim 9, characterized in that the functionalization of said nanotubes is performed using a functional group containing an alkyl chain C_6H_3-R.

11. The method according to Claim 10, characterized in that said functional group derives from benzyne or its derivatives.

12. The method according to Claim 10, characterized in that it further comprises the step of effecting a Friedel and Crafts alkylation.

13. The method according to Claim 9, characterized in that the functionalization of said nanotubes is performed locally using carboxyl groups.

14. The method according to claim 10, characterized in that it further comprises the step of oxidizing the alkyl chains to obtain carboxyl groups –COOH.

15. The method according to Claim 14, characterized in that it further comprises the step of protecting said carboxyl groups by esterification with an alcohol R-OH.

16. The method according to claim 3, characterized in that it comprises the step

of functionalizing said DNA strands using thiol groups.

17. The method according to Claim 3, characterized in that it comprises the step of contacting said first nanoelectrodes and said DNA strands.

18. The method according to Claim 3, characterized in that it comprises the step of selectively hybridizing said DNA strands to write the logic state "1".

19. The method according to Claim 3, characterized in that it comprises the step of not hybridizing said DNA strands to write the logic state "0".

20. The method according to Claim 3, characterized in that it comprises the step of removing said non-hybridized DNA strands by washing.

21. The method according to claim 3, characterized in that it comprises the step of contacting said hybridized DNA strands and said non-hybridized DNA strands by means of an orienting electric field between said array of second nanoelectrodes and said nanotubes to form the amide bond –CONH–.

22. A method for determining whether a DNA molecule contacting a first nanoelectrode and a second nanoelectrode formed on a substrate has been hybridized, characterized in that it comprises the steps of:
- applying an electrical field between said first and second nanoelectrodes;
- detecting whether an electrical current flows between said first and second nanoelectrodes;
- determining whether said DNA molecule has been hybridized on the basis of the outcome of said electrical current flow detection.

23. The method according to Claim 22, characterized in that said step of determining whether said DNA molecule has been hybridized comprises the steps of:
- determining that said DNA molecule has been hybridized if an electrical current flows between said first and second nanoelectrodes.

24. A sensor for determining whether a DNA molecule contacting a first

nanoelectrode and a second nanoelectrode formed on a substrate) has been hybridized, characterized in that it comprises:
- means for applying an electrical field between said first and second nanoelectrodes;
- means for detecting whether an electrical current flows between said first and second nanoelectrodes; and
- means for determining whether said DNA molecule has been hybridized on the basis of the outcome of said electrical current flow detection.

25. The sensor according to Claim 24, characterized in that said determining means determines that said DNA molecule has been hybridized upon detection of an electrical current flowing between said first and second nanoelectrodes.

26. A memory device, comprising:
a plurality of memory cells, each memory cell including at least one DNA strand;
a plurality of carbon nanotubes, each carbon nanotube being electrically coupled to associated ones of the memory cells;
a substrate; and
a plurality of nanoelectrodes formed on the substrate, each nanoelectrode being electrically coupled to associated ones of the memory cells.

27. The memory device of claim 26 wherein each memory cell stores data by hybridization of the corresponding DNA strands.

28. The memory device of claim 26 wherein the substrate comprises silicon dioxide.

29. The memory device of claim 26 wherein the nanoelectrodes comprise polysilicon.

30. A computer system, comprising;
a memory device comprising,
a molecular memory including,
storage elements made by means of DNA strands, and

connection means made by means of carbon nanotubes for electrically contacting said storage elements.

31. The computer system of claim 30 wherein the storage of information in the storage elements is obtained by hybridization of said DNA strands.

32. A method of storing data in a molecular memory device, comprising:

forming a plurality of memory elements, each memory element including DNA strands;

forming a plurality of carbon nanotube conection elements coupled to the memory elements;

forming a plurality of nanoelectrodes; and

selectively hybridizing the DNA strands in each memory cell to store the desired data in the memory cell.

33. The method of claim 32 wherein forming the nanoelectrodes comprises:

forming an insulating substrate; and

forming the nanoelectrodes on a surface of the substrate.

34. The method of claim 32 further comprising making the nanotube connection elements suitable for contacting the DNA strands.

35. The method of claim 34 wherein making the nanotube connection elements suitable for contacting the DNA strands comprises functionalizing the nanotube connection elements.

36. The method of claim 32 wherein forming a plurality of nanotube connection elements comprises forming the plurality of nanotube connection elements through a chemical vapor deposition process.

37. The method of claim 32 wherein forming a plurality of nanoelectrodes comprises forming a plurality of polysilicon nanoelectrodes.